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SOUND HOLES AND GEOMETRICAL FIGURES

Clues to the Terminology of Ancient Mesopotamian Harps

By BO LAWERGREN and O. R. GURNEY

In general this article concerns harps and lyres in Mesopotamia. We begin by considering sound holes on harps and proceed to inquire into the names of both types of instruments and the geometrical shapes associated with the instruments and sound holes.

A. MONUMENTAL EVIDENCE FOR SOUND HOLES ON HARPS

On the sides of the vertical harps on the Assyrian Palace reliefs in the British Museum one observes a characteristic geometrical figure inscribed in a consistent manner. The figure resembles a rectangle the sides of which are concave (Plate Xa).

The oldest (653 B.C.) vertical harps shown on these reliefs¹ are played by seven members of King Teumman's Elamite orchestra (S. W. Palace at Nineveh, BM 124802, detail here, Plate Xb). Most of these harps are marked with a pair of concave-sided rectangles. There are six clear marks, five places are too eroded to show distinct marks and three places seem to lack marks. The sculptor's skill and care varies from harp to harp and the workmanship seems generally poor for the instruments where the rectangles are missing.

In Assurbanipal's North Palace at Nineveh (645–635 B.C.) there are two meticulously carved musical scenes (BM 124920, 124922) where vertical harps (Plate Xc) are marked with pairs of concave rectangles. Each mark is framed by a narrow border and its centre is gouged deeply into the side of the instruments as if representing a hole through the side of the body (Plate Xa). On the other hand, in the Elamite harps the interior of each concave rectangle is flush with the surrounding. However, in view of their poorer workmanship, these rectangles are probably also meant to represent holes.

Vertical harps also existed in Egypt during this time. They closely resemble the Assyrian harps but lack the concave rectangles. Some extant Egyptian harps are known² and their construction indicates that the harp body was made from a single piece of wood hollowed out to form a U-shaped cross section. The body was completely wrapped in thin leather, closing the top of the U where it formed the sound board. The thickness of the wooden sides (i.e. the verticals of the U) is about 15 mm in one Egyptian harp. The gouged centres in the concave rectangles, mentioned above, would most likely have penetrated such relatively thin sides.

Holes of the type found in the sides of Mesopotamian harps seem to have had a long history prior to the 7th century. Well preserved relief plaques (1950–1530 B.C.)

¹ See e.g., R. D. Barnett, *Sculptures from the North Palace of Ashurbanipal at Nineveh (668–627 B.C.)* (London, 1976); Joan Rimmer, *Ancient Musical Instruments of Western Asia in the British Museum* (London, 1969); Subhi Anwar

Rashid, *Mesopotamien, Musikgeschichte in Bildern* (VEB Deutscher Verlag für Musik, Leipzig, 1984).

² C. Ziegler, *Les Instruments de musique égyptiens au Musée du Louvre* (Paris, 1979), pp. 104–6.

of vertical angular harps³ show X-shaped incisions on the upper part of the harps. Considering the small size and the limited means available in making the terracotta casts, these X-shaped marks may well represent more elaborate geometrical figures such as concave rectangles.

Concave rectangles are also found on horizontal harps of the Altai people dating between 650 and 500 B.C. The *top* surface of an extant *horizontal* harp from Pazyryk⁴ has a hole (Plate XIa–b) of exactly the same shape as the concave rectangular marking on the *side* of Mesopotamian *vertical* harps. Here the hole functions as a sound hole in a similar way to those in modern string instruments such as violins and guitars. The excavator of Pazyryk, Rudenko, has demonstrated that many (non-musical) grave objects show stylistic influences from Achaemenian Persia.⁵ The shape of the sound hole gives independent evidence in support of his conclusion since it shows Mesopotamian (and Iranian?) influence but it is surprising to observe this feature, associated with vertical harps, adapted to horizontal harps. One cannot exclude the possibility that Mesopotamian horizontal harps also may have had these kinds of sound holes since we only have side views which, strictly speaking, should give no information about holes on the top surface. That there are no markings on the sides is clear from the depictions on several OB terracotta plaques⁶ and from several illustrations of Assyrian⁷ as well as Elamite⁸ harps on the Palace reliefs in the British Museum. However, as shown in Plate XIc, the sculptor of the Elamite harps may have attempted to present the instruments from two view points.⁹ The surface with the nine round holes may be meant to lie in the horizontal plane or, at least, slope inward/upward. If so, horizontal harps—at least in this Elamite orchestra—seem not to have had concave rectangular markings and the round markings were sound holes punched in the leather which was stretched across the top of the body. That is also the location of the sound holes in the extant Egyptian vertical angular harps.²

Thus, the monuments show that vertical harps had holes of a characteristic shape. There is some slight indication (from the very peripherally located Altai region) that horizontal harps may have had such holes too.

³ Clear X-shaped marks are seen on four Old Babylonian plaques in the Iraq Museum in Baghdad (IM 41649, IM 41894, IM 42012, IM 21359; Rashid, *Mesopotamien*, 80–5) and one in Musée du Louvre (AO 12453) [said to come from Ešnunna, see: E. Strommenger and M. Hirmer, *The Art of Mesopotamia* (London, 1964), fig. 143]; all seem to be made from the same mould. A plaque made from a different mould (IM 41590) (Rashid, p. 83) shows indistinct marks; from yet another mould comes a terracotta in Florence [Furlani, “Terrecotte babilonesi del R. Museo Archeologico di Firenze”, *Aegyptus* 12 (1932) 127, fig. 5] which, unfortunately, showed only the lower part of the harp.

⁴ B. Lawergren, “The Harp of the Ancient Altai People”, *Proceedings of the Second Conference of the ICTM-Study Group on Music Archaeology*, vol. I, 163–177, ed. Cajsa Stomberg-Lund (Stockholm, 1986); also Bo Lawergren, “The Ancient Harp from Pazyryk, *Beiträge zur allgemeinen und vergleichenden Archäologie* (1987,

forthcoming).

⁵ S. I. Rudenko, *Frozen Tombs of Siberia* (Berkeley, 1970), 293 ff.

⁶ From Iraq Museum (IM 41701, IM 21314, IM 31037) and Musée du Louvre (OA 12455) [Rashid, op. cit., 86–7], all made from the same mould; the harp shown in Léon Legrain, *Terra-cottas from Nippur* (University of Pennsylvania, 1930), fig. 93, comes from another mould.

⁷ (a) Nimrud, N. W. Palace (865–860 B.C.) BM 124533, 124535, 124550; (b) Nineveh, Temple of Ishtar (704–681 B.C.) BM 124948; (c) Nineveh, N. Palace (645–635 B.C.) BM 124886.

⁸ Nineveh, S. W. Palace (653 B.C.) BM 124802; see T. C. Mitchell, “An Assyrian Stringed Instrument”, in *Yearbook of the British Museum* 4 (London, 1980), 33–42.

⁹ Such a system of dual vantage points was used in a scene directly above the Elamite orchestra where houses are drawn in side view while a river is shown from a bird’s point of view (Rimmer, op. cit., pl. XIV a).

B. WRITTEN EVIDENCE FOR SOUND HOLES ON HARPS

A mathematical tablet shows a geometrical figure closely resembling the shape of the sound holes shown on the monuments.¹⁰ The figure is a concave tetragon formed in the space between four circles with their centres lying at the corners of a square (see Appendix and Plate XIIb). Its name is given as GEŠTÚ.ZÀ.MÍ (= Akkadian *hasīs sammī*), “ear of the *sammū*-instrument”. In view of the similarity of shape, is this the name for the sound holes we are considering, as already suggested in *CAD*, vol. 6 (1956), s.v. *hasīsu*, “ear”? It would be a not inappropriate name for a hole for letting out sound, the ear being a passage for letting in sound; and indeed confirmation may be seen in the line of a commentary: ÁB.ZÀ.MÍ // *ha-si-si* // áš-šú U *ap-ta šá sa-am-mu-ú*, “ÁB.ZÀ.MÍ = ear, because (it is) a hole, a window in the *sammū*-instrument” (H. Hunger, *Spätbabylonische Texte aus Uruk*, 72 rev. 11). However, there are difficulties.

First, the “ear” (*hasīsi*) is found in the lexical text HAR-ra = *hubullu*, VIIB line 86, among parts of the *sammū* but with the Sumerian equivalent ^{giš}kak zà.mí. In her article on the lyre in *Reallexikon der Assyriologie* VI, 573, Prof. Kilmer translates this “ear, intelligence”, but this only renders the Akkadian word. The Sumerian ^{giš}kak means “peg”, and tuning pegs, made of wood or ivory, are well attested as parts of musical instruments such as the *sabītum* (Spycket, *An. St.* 33 (1983), 46). Was it these, perhaps, that were called “ears” in Akkadian (suggested by their protuberance)? This does not really seem likely. The *hasīsu* is properly the aperture of the ear, not the outer auricle. The normal Akkadian equivalent of ^{giš}kak is *sikkatu*, and though this word does not seem to be attested for the pegs to which the strings were attached, it would certainly have been the natural word for them. The line with this equivalence comes from two late school tablets and we would suggest that in the course of transmission a scribe has conflated two lines:

86. ^{giš}kak zà.mí < = *si-ik-ka-tu* >

86a. <GIŠ.TÚG.PI(= *geštú*) zà.mí> = *ha-si-si*

Secondly, though we here have two texts attesting the “ear” as a feature of the *sammū*-instrument, the *CAD* in its latest volume (1984) gives *sammū* unequivocally the meaning “lyre”, but there is no evidence that ancient lyres had sound holes of this peculiar shape. All the lyres that Woolley excavated at Ur lacked sound holes on the front, back, side or top surfaces. At least two lyres were so skilfully excavated that the original, detailed, shapes can be seen: the “silver lyre” and the “plaster lyre” [nos. U. 12354 and U. 12351 in C. L. Woolley, *Ur Excavations II, The Royal Cemetery*, (London and Philadelphia, 1934)]. Silver foil covered the former instrument along all surfaces (pl. 111 in the excavation report) and there were no openings for sound holes except, possibly, along the narrow bottom surface. The rear side of the plaster lyre is well preserved (pl. 118) and shows no holes or irregularities which could be interpreted as sound holes. Many pictures show front views of lyres but there is never any indication of sound holes. A representative collection is displayed in Rashid, *Mesopotamien* (see n.1), figs. 8, 36, 45, 78, 79. Only the lyre on the “peace” side of the

¹⁰ BM 15285, published by H. W. F. Saggs in *RA* 54 (1960), 131–46, with a (rather poor) photograph. For a drawing of the part of the tablet containing the geo-

metrical figure it is necessary to refer to the earlier publication of one of the joined fragments by C. J. Gadd in *RA* 19 (1922), 149–58.

“standard” from Ur (fig. 11 in *Mesopotamien*) seems to have a marking on its body that may be a sound hole, but its triangular shape is distinctly different from the concave tetragon of the mathematical tablet. There must indeed have been vent holes in these box-like lyre bodies, otherwise the air in the box would have no way to escape when weather conditions (temperature and/or pressure changes) so require. It seems likely that the bottom surface was simply left open. This design existed in the “thin” Egyptian lyres of 18th Dynasty. Extant examples are at Leiden,¹¹ New York¹² and Cairo.¹³ In particular, the “silver” lyre seems to have had an open bottom as “sound hole”. But, of course the bottom might have been simply covered with wood, being invisible. Scholars who rely entirely on the frontal views of lyres shown on the pictorial evidence may be tempted to speculate that sound holes, shaped like concave tetragons, existed on the back of the lyres, hidden from our view. But the silver and the plaster lyres from Ur prove that this speculation is without foundation. Further evidence against this view can be seen on the ancient Egyptian “fat” lyre. This, indeed, was a lyre with a sound hole (circular in outline) but it was placed centrally on the front, facing the player, not hidden on the back. A clear example is in West Berlin [Curt Sachs, *Die Musikinstrumente des alten Ägyptens* (Berlin, 1921); lyre no. 73]. In fact, we know of no lyre, from any epoch or region, which had a sound hole on its back.

If, then, it was only harps that had sound holes in the form of concave rectangles, but the only instrument attested as having “ears” of this shape is the *sammû*, could the *sammû* after all be not a lyre but a harp?

C. THE *zà.mí/sammû*: LYRE OR HARP?

Up to about 1972 most scholars were very cautious in assigning the numerous names in the texts to particular instruments. Stauder in the *Reallexikon der Assyriologie*, IV, s.v. Harfe, writes that there are many names of string instruments but none can be unequivocally assigned to the harp. “In the ancient East it seems that musical instruments were classified not according to form, material or the manner of sound production, but more by their function and use.” Henrike Hartmann in her book *Die Musik in der sumerischen Kultur* (1960) discusses the various names at some length but is unwilling to commit herself definitely to “harp” or “lyre” in the case of the *sammû*. Von Soden in his dictionary (c. 1972) gave “Harfe, Leier”, and the translation “harp” appears without comment in a very recent book.¹⁴ The unequivocal “lyre” of the *Chicago Assyrian Dictionary* (CAD) appears to rest mainly on the views of two scholars, Ann Kilmer and Marcelle Duchesne-Guillemin.

Mme. Duchesne-Guillemin argued in 1969¹⁵ that in the lexical list HAR-

¹¹ P. A. A. Boeser, *Beschreibung der Aegyptischen Sammlung des Niederländischen Reichsmuseums der Altertümer in Leiden* (den Haag, 1910), 7, no. 69, and pl. XXII, no. 18.

¹² W. C. Hayes, in *The Scepter of Egypt* II (Cambridge, 1959), describes the lyre on p. 24: “It is open at the bottom”.

¹³ Nos. 69417 and 69418 in the Cairo Museum as described by H. Hickmann in *Instruments de Musique* (Le Caire, 1949), fig. XCV A and B, and fig. XCIV B. He

states “la boîte de résonance est ouverte en bas, sauf au centre”.

¹⁴ A. Livingstone, *Mystical and Mythological Explanatory Works of Assyrian and Babylonian Scholars* (Oxford, 1986), p. 95, line 3. Similarly in the new Pennsylvania Sumerian Dictionary, ed. A. W. Sjöberg, B (1984), the Sumerian *balag* is given as “lyre and/or harp” and translated “lyre” throughout.

¹⁵ *Revue de Musicologie* 55 (1969), 10–11.

ra = *hubullu* (Hh) there is a *zà.mí* instrument dedicated to Ishtar; it should therefore be the same instrument as the *zannaru*, which is the Sumerian “instrument of Ishtar” (giš.^dINANNA) and the Hittite *zinar*, with its large and small varieties, and can be identified on the Inandik vase (R. M. Boehmer, *Die Reliefkeramik von Boğazköy* (Berlin, 1983), 21) as the large and small lyre. The identification of the *zannaru/zinar* with the lyres shown on the Inandik vase is indeed plausible,¹⁶ but there is no reason to suppose that only one type of instrument would be used in the cult of Ishtar. Lines 64–65, with the “praise instruments” (giš.^{zà.mí} and giš.^{ár.ri}) of Ishtar, may have been attracted to this position—or even interpolated there (they are not in the forerunners)—merely on account of the reference to Ishtar/Inanna in the Sumerian name of the *zannaru* in line 63. The “bison instrument” (giš.^{gu}.₄[alim]) of line 66 might then be the bovine lyre, continuing the lyre section after this two-line interruption (though not if this word denotes the mythical human-headed bull-man). The “lion instruments” that follow might be lyres of the type carried by a stone statuette from Cyprus (Bo Lawergren, “The Cylinder Kithara in Etruria, Greece and Anatolia”, *Imago Musicae* I (1984), 147–74, Fig. 2 and p. 152); but no such lyres are known from Mesopotamia.

Now in a second article the same year¹⁷ Mme. Duchesne-Guillemin sought to show that the *algar*-instrument was the horizontal harp, both the arched variety shown on the Bismaya vase fragment (Chicago A 195; Rashid, *Mesopotamien*, 56) and on the terracotta plaque from Eshnunna (Louvre AO 12454; Rashid, 88) and also the angular type with the strings attached to a pole which appears in the monuments (note 6) somewhat later. The *algar* is found in Sumerian literary texts of the third millennium as an instrument of major importance, but from the Old Babylonian period onwards it appears only in lexical lists.¹⁸ Five of these literary texts contain passages listing the instruments played by temple musicians,¹⁹ and in most of these the *zami* and the *algar* figure in first and second place: see Table 1. We may be sure that one of these is the lyre which, in view of the great lyres from the royal tombs at Ur and the many representations on the monuments, could hardly have been omitted regularly in such a context, though its common name has not yet been certainly identified.²⁰ So, if the *algar* was the horizontal harp, as claimed by Mme.

¹⁶ See Gurney, *Some Aspects of Hittite Religion* (1977), 34–35. Professor Kilmer, *RIA* VI 573, following A. Sjöberg, *OIAS* 16, 65, considers it to be an ear-shaped harp, on the basis of Nabnitu XXV (= L) 177 (*MSL* XVI 228). But as long as the coupling of *za-na-ru* with *za-na* in this list (which has nothing to do with musical instruments) remains unexplained (see Sjöberg, loc. cit.), we prefer to rely on the Hittite evidence, for there are few harps on the Hittite monuments and they do not vary in size. We follow Sjöberg in reading the Sumerian giš.INNANA/INNIN rather than giš.mùš.

¹⁷ *JNES* 28 (1969), 109–15.

¹⁸ See *CAD* s.v. *alû* (a drum), with which *al.gar* is equated in Hh VII B 45 and *Nabnitu* XXXII, col. iii; cf. *balag*, M. Cohen in ref. 20, below.

¹⁹ (1) Gudea Cyl. B, col. x (translated Falkenstein, *Sumerische und Akkadische Hymnen und Gebete* [1953], 173–4). (2) *Šulgi Hymn* B 162–9 (edited by G. R. Castellino, *Two Šulgi Hymns* [Rome, 1972]). (3) *Inanna Hymn* of Iddin-Dagan 204–6 (edited by W. H. P.

Römer, *Sumerische Königshymnen der Isin-Zeit* [Leiden, 1965], 128 ff.). (4) Enki's Journey to Nippur 62–7 (edited by A. al-Fouadi [University Microfilms, Ann Arbor 70–7772, 1969]). (5) 3NT 386 (unpublished, line 15 quoted *AS* 16, (1965), 64, line 14 by al-Fouadi, op. cit. p. 131, transcript now kindly provided by Prof. M. Civil). We deliberately exclude the Curse of Agade, Examenstext A, *Šurpu* III and *ABRT* 55, all of which contain such passages, because their date of composition is uncertain, also *BBS* 35 rev. 2, which is late Babylonian.

²⁰ Gudea is said to have placed a *balag* (probably an arched harp at this time, cf. M. Cohen, *SANE* I(2), 31) alongside an instrument named “Cow Abundance” which from its bovine shape can only have been a lyre, but the common name of this instrument is unfortunately not mentioned in the text (Nanše Hymn 40–4, for which see W. Heimpel, *JCS* 33 [1981], 84, 103 f., and Kilmer *RIA* VI, 574 a).

TABLE 1
Instruments ranked in order of occurrence in each text

<i>Instrument</i>	<i>Gudea</i> <i>Cyl. B</i>	<i>Šulgi</i> <i>B</i>	<i>Inanna</i> <i>Hymn</i>	<i>Enki's</i> <i>Journey</i>	<i>3NT 386</i>
<i>zami</i>		1	3	1	1
<i>algar</i>	2	3	2	2?	
<i>algarsurra</i>				3	3
<i>harhar</i>		7		4	6
<i>sa 3</i>					4
<i>sa 30</i>		2			
<i>sabitum</i>		4		5	5
<i>mirutum</i>	3	5		6	
<i>zanaru</i>		8			7
<i>gudi</i>		9	1		2
<i>urzababutum</i>		6			
<i>tigi</i>	1				

Duchesne-Guillemin, it would be highly probable that the *zami* was the lyre. However, the arguments adduced by her for this identification are, without exception, flawed. (a) On the basis of a line in the Inanna Hymn of Iddin-Dagan she claimed that the *algar* was played with a plectrum; but the passage was quoted from the old edition by M. Witzel, and he had misread the text, as she acknowledged in a supplementary note the following year.²¹ (b) The lexical list *MSL* VI, 122 no. 61, cited by her (p. 109 n. 4) as evidence that the *algar* was of Elamite origin, had been wrongly restored; the new edition (see below) shows that it was not the *algar* but the *balag.di* (*timbuttum*) that has an Elamite variety. (c) The occurrence in another lexical list of an “arm of the *algar*” (á-^{gis}al-[gar]) was adduced to show that, since only *one* arm is mentioned, the *algar* must be the horizontal harp; but the fact that the entry is not preceded by the figure 2 does not prove that the instrument had only one such “arm”; it is a lexical list, not an inventory.²² (d) The claim that the instrument was played with a plectrum was supported by reference to the *algarsurra* which was interpreted as a plectrum or drumstick by the *CAD*; but new evidence has come to light and the *algarsurra* is now held to be another stringed instrument, a sub-type of the *algar*.²³ It seems in fact that *algar* could well be the name for the Sumerian bovine lyre, which also had “arms”, leaving *zami* as the name of the angular harp. The term *za(n)naru* (a foreign—Hattic?—word), which occurs but rarely in literary contexts (see Table 1), may have replaced *algar* as the name for the lyre when the new, smaller lyres were introduced (from Syria?—see D. Collon, “Leier”, *RIA* VI, 581) and the *algar* became obsolete.

²¹ *JNES* 29 (1970), 200–1.

²² The reference is to *Nabnitu* XXXII, now *MSL* XVI 252 line 11, in a passage listing parts or accessories of the *algar*, where the Akkadian column is unfortunately lost.

²³ See al-Fouadi, op. cit. (n. 19), 131; cf. J. S. Cooper, *The Curse of Agade* (Baltimore, 1983), 1. 35. The passage

of *Nabnitu* just mentioned contains a sur-^{gis}al-[gar] which, being an accessory of the instrument, might be thought to support the view that the al-gar-sur-ra was a plectrum; but there is no proof that the two are the same.

Prof. Kilmer²⁴ has translated *zà.mí/sammû* as “lyre” consistently since 1960, but her arguments in favour of this translation appeared only in 1983 in her article “Leier” in the *Reallexikon der Assyriologie*. They too are based mainly on lexical lists. When first published, the section devoted to musical instruments (Hh, VIIB, 39 ff.) was very fragmentary. It begins with *giš.balag*, which in its original pictographic form clearly represents an arched vertical harp.²⁵ In the old text this section ran into a lacuna after only four lines, but the gap has now been eliminated and the section continues with types of *balag* and other instruments, such as the *algar*, here strangely equated with *alû*, a drum, at least till line 57. The *zannaru* (*giš INANNA*) comes at line 63 (old 81), followed by the *giš.zà.mí*^dINANNA, as mentioned above. After line 68 there is still a large lacuna, into which must be placed a section, now augmented by recently identified fragments, devoted to varieties and parts of the *giš.zà.mí/sammû*. This section is not linked to the rest of the text at either end. The main text begins again at line 111 after a gap of unknown length, with the *šinnatu*, a wind instrument, and (after a division line) the *inu*, possibly the lute.²⁶

Kilmer assumes that lines 39–63 are concerned with harps and that line 64 (*giš.zà.mí*^dINANNA = [ŠU?], i.e. *sammû ša*^d*Ištar?*) begins a new section devoted to lyres, under the name *zà.mí*. This looks plausible, since the reference to *zà.mí* first occurs at line 64, continues with instruments in animal forms and runs through most of the lacuna in the main text. But a true section of the list should start with the generic name of the instrument, in this case *zà.mí* = *sa-am-mu-u*, just as the harp section starts with *balag* = *ba-lag-gu* and the lute section with *gù.dé* = *i-nu*, and Prof. Kilmer infers that such a line has to be restored somewhere in the gap before the section listing the parts of this instrument. If this is correct, however, it would mean that lines 64–68, with the first reference to *zà.mí* and the animal forms, are not part of the *sammû* section and cannot be used to prove that the *sammû* was a lyre. The long section 34a–117, in which there are apparently no division lines, begins with agricultural tools, passes on to the harp (*balag*) and the *alû* (a drum), but returns to the *balag* harps and other string instruments (*zannaru* and *sammû*) and ends with a section of wind instruments, only to be followed by another section devoted to a string instrument, the lute. The principle of arrangement is by no means clear, and it seems that the introduction of lyres (*zannaru*) at line 63 would not preclude a return to another kind of harp or perhaps a more general word for a stringed instrument—the “praise” instrument—somewhere in the lacuna.

The apsamikku

But it is not only the lexical lists that are held to prove that *sammû* is the lyre. In the note already mentioned (note 14 above) Prof. Kilmer remarked that *GEŠTÛ.ZÀ.MÍ*, “ear of the lyre”, “seems to denote the same geometrical figure as the *ÁB.ZÀ.MÍ*, ‘cow of the lyre’.” This point is developed in the *CAD*, s.v. *apsamikku* (1968), and in the article “Leier” in the *Reallexikon* already mentioned, where it is argued that the concave-sided tetragon was named “cow of the lyre” from the stylized rendering of

²⁴ In her article “Two new lists of key numbers for mathematical operations”, *Orientalia* 29 (1960), 286 n.1.

²⁵ See Stauder, op. cit., 115.

²⁶ We are indebted to Prof. M. Civil of Chicago for a transcript of the section as now revised.

the bovine nose seen on the frontal view of all bovine lyres. Such bovine shapes are of course not seen on harps. This explanation may seem somewhat far-fetched; indeed A. Goetze had suggested in 1951²⁷ that the term *apsamikku* had a different meaning derived from AB, “aperture”, and ZĀ.MĪ, literally “window of the *sammû*”, and the line of the commentary quoted above, p. 39, explaining it as “a hole, a window of the *sammû*”, would appear to confirm this interpretation (ĀB in ĀB.ZĀ.MĪ being a purely phonetic variant). The “window” (*aptu*) could then be another name for the sound hole, which is peculiar to the harp. But is *apsamikku* in fact a concave-sided tetragon, as alleged by Kilmer?

The “key numbers” (or “coefficients”) of the lists assembled by Kilmer are termed *igigubbû* in Babylonian and are assigned to various objects or entities, including some geometrical figures. In the case of geometrical figures these numbers should define the proportions of the figure (the shape being given by the name) in terms of its dimensions and area. Thus, in a circle the basic dimension is taken to be the circumference (L) and the coefficient, 5, defines the area (A), because for a circle, if π is taken as 3

$$A = \pi R^2 = \frac{L^2}{4\pi} = \frac{L^2}{12}$$

which in sexagesimal notation would be 5 L² (strictly 0;5 L², using the semicolon to mark the point of division between integers and fractions). In most cases only the coefficient for the *area* is given and if the shape is unknown this is obviously insufficient to define it. This is the situation with the *hasīs sammī*, the coefficient of which is shown as 26,40; but the shape of this is known from the mathematical tablet, Plate XIIb (see above, p. 39), and we show in an appendix that in this case also the coefficient can be connected to the area.

In some instances, however, other dimensions are given. Thus, in the list from Harmal edited by Goetze in the above-mentioned article, the area(?) of a triangle is entered as 26,15 and the *tallu* as 52,30 and Goetze has shown that if the side (*šiddu*) of an equilateral triangle is taken as 1 and $\sqrt{3}$ as approximately 1;45, the altitude is 0;52,30 and the area 0;26,15. It is more practical to modify this result by taking the side as 60 (which in the absence of a sign for zero was also written 1), the *tallu* as 52,30 and the area as 26,15 (Fig. 1). In a list from Susa²⁸ only the figure 52,30 is entered as the coefficient for the (area of the) triangle, probably in error.²⁹

In the case of the *hasīs sammī* only one coefficient (26,40) is given and it is for the area (as shown below in the appendix). For the *apsamikku*, however, though the same number, 26,40, is given for the area, other numbers are entered for particular dimensions of it, namely the *tallu* (48), the *pirku* (33,20) and the *šiliptu* (1,20). The fact that the *hasīs sammī* and the *apsamikku* have one coefficient in common cannot be said to prove that they are the same figure.

²⁷ A. Goetze, “A mathematical compendium from Tell Harmal”, *Sumer* 7 (1951), 137–8.

²⁸ E. M. Bruins and M. Rutten, *Textes mathématiques de Suse, Mémoires de la Mission archéologique en Iran XXXIV* (1961) (henceforward *MDP* 34), text III.

²⁹ It appears as if somewhere in the transmission a scribe has again conflated two lines:

Original text (see Goetze, *Sumer* 7, 137):

<i>santakkum</i>	26,15	<i>i-gi-gu-bu-šu</i>
<i>ta-al-li santakki</i>	52,30	<i>i-gi-gu-bu-šu</i>

Corrupted to:

<i>*santakkum</i>	52,30	<i>i-gi-gu-bu šu</i>
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Susa scribe: (new style)

52,30	IGI.GUB	<i>ša santakki</i>
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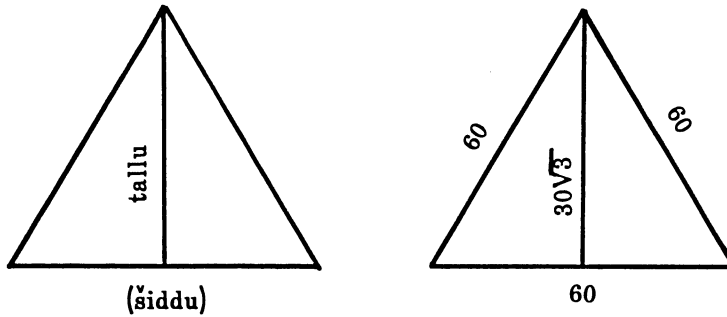


Fig. 1.

From these data Goetze worked out the shape of the *apsamikku* as a trapezium consisting of a right-angle triangle with a thin rectangle attached to one side (Fig. 2). The use of *tallu* here is similar to that in the triangle, where it denotes the altitude, and the *pirku* is known from other examples to denote a line dividing the figure and parallel to one side.³⁰ If the *pirku* is drawn from the mid-point of the base to the mid-point of the opposite oblique, the area of the figure would be the product of the *tallu* and the *pirku*, $48 \times 33,20$, and if the latter figure is taken as $33,20$ the area is precisely $26,40$; ($= 1600$ decimal), which is a good reason for supposing that the figure is correct. This figure is not unlike an angular harp, and Goetze who, on Landsberger's authority, thought at the time that the *sammû* was most probably a harp, suggested that the figure represented the frame over which the strings were attached (AB "window" having here the sense of "(window) frame").

Among the mathematical texts from Susa edited by Bruins and Rutten in *MDP* 34 (see above, note 28) there are also two problem texts relating to the *apsamikku*. These authors did not consider the data sufficient to define the *apsamikku*, but recently Mlle. Spycket has discussed a part of text XXI and has proposed³¹ a solution resulting in a

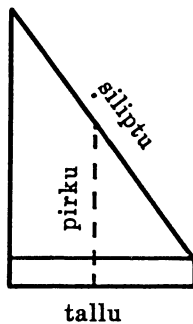


Fig. 2a.

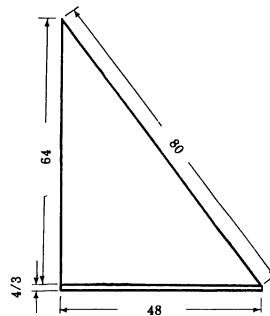


Fig. 2b.

³⁰ F. Thureau-Dangin, *Textes mathématiques babyloniens* (1938), 223; *MDP* 34, 20.

³¹ Agnès Spycket, "Louez-le sur la harpe et la lyre", *An. St.* 33 (1983), 39–49.

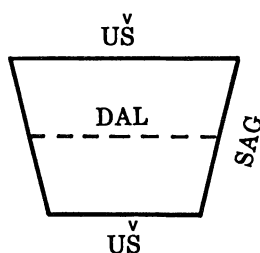


Fig. 3.

figure strongly resembling a lyre rather than a harp (Fig. 3). This figure is deduced from the last five lines of a long problem text of which the beginning is damaged and the middle section, between the obverse and the reverse, is missing. The solution in the last three lines assigns values to the *šiddu* “length” (written UŠ), the *pūtu* “width” (written SAG) and the dimension written RI (better DAL), which is normally read either *tallu* or *pirku* (cf. *MDP* 34, p. 20). Before this there are references to the *šiddu* of the *apsamikku*, which appears to have a different length from that in the solution (30 instead of 50) and a DAL of the *apsamikku*, evidently referring back to the *apsamikku* mentioned in obverse 6. The text also operates with a *messētu* of the *šiddu* (value 10), a *messētu* of the *pūtu* (value 5), and on the obverse an *eqel birīti* (written A.ŠA DAL.BA.NA), “area of the space between”. The *messētu* and the *eqel birīti* are characteristic of problems dealing with one figure drawn within another, such as *MDP* 34, text V (p. 47).³² The *messētu* “distance” is the distance between the side of the outer figure and the (parallel) side of the inner figure;³³ the *eqel birīti* is the space between the two figures, calculated by subtracting the area of the inner from the area of the outer. That text XXI is a problem (or perhaps two related problems) of this kind is further suggested by the remains of its first line, where the signs TJA.ĀM appear after the break; for this distributive suffix, meaning “each”, occurs in mathematical texts in the phrase 5.TA.ĀM, *ad-ku-uš*, “I indented 5 (from) each (side)” (or “I formed a border of 5”),³⁴ which describes the process of drawing the inner figure in such a way that the distance between the figures (the *messētu*) is 5. The word following TA.ĀM in line 1 is not *ad-ku-uš*. It has been read <a>-bu-sà-am-m[i-kī], though the signs are by no means clear. If this is correct, it would seem to suggest that the outer figure is an *apsamikku*, but Mr. J. Ritter, who has kindly collated the tablet for us, considers this reading to be impossible. Perhaps then the *apsamikku* is the inner figure. The verb at the end of the damaged second line could possibly be read *ad-d[i]*, “I have drawn”.

Mlle. Spycket has not considered the obverse at all, and has drawn a single figure, assuming it to be an *apsamikku*. Following Bruins, she has assumed that both the “lengths”, 30 and 50, belong to this figure and has assigned them to the two parallel sides, though, as shown by Thureau-Dangin,³⁵ the parallel sides (or “bases”) of a

³² The correct reading, *messētu(m)*, and the meaning were established by Kilmer in *Studies presented to A. Leo Oppenheim* (1964), 142 n.9.

³³ So Kilmer, loc. cit., and the *Chicago Assyrian Dictionary*, 10, part II (1977).

³⁴ Kilmer, op. cit. 140 line 10, and Saggs, op. cit.

(n.1), *passim* (with PAD.TA.ĀM). This TJA.ĀM suggested to Bruins a progression of 5 lengths (4 sides and 1 diagonal) increasing in steps of 5 (the *messētu*). But this would be a different use of *messētu* from that which he established on p. 46 (“distance between sides”).

³⁵ *RA* 31 (1934), 61–9. In the text there edited (a new

trapezium are called *pūtu*, “width”. For *messētu* she adopts Bruins’ reading *miššitu* and his translation “accroissement” (augment), which the modern dictionary has abandoned, and she gives it a meaning which is inconsistent with *MDP* 34, Text V. She takes the DAL to be a *pirku* (line parallel to the base), but again following Bruins she reads it *šiliptu* because its coefficient is given (in obv. 6) as 1,20 and the same number must be restored in rev. 6. This should be the oblique side, but according to her interpretation the oblique side is the *pūtu* (SAG). In view of all these discrepancies we cannot believe that Spycket’s figure is a correct solution of this problem. But the strange assignment of the number 1,20 to the DAL is inherent in the text and this, together with the many lacunae, make the proposal of any alternative solution very difficult. It may be added that the area of Spycket’s figure would be 1755 (29,15 sexagesimal), which is much greater than the 26,40 required by the coefficient.

The other text from Susa concerning the *apsamikku* is Text XX, which contains two problems, and though only the left half of the tablet is preserved, it is completely restorable and intelligible, as shown by Bruins. The problem deals with a particular example of the figure; the linear coefficients must therefore be multiplied by a factor *L*, which remains to be determined, the area being multiplied by *L*². The sum of the area (*eqlu*) (26,40) the length (*šiddu*) (1) and the diagonal (*šiliptu*) (1,20) is said to be 1,16,40 (sexagesimal) which may mean either 1,16;40 (= 76 $\frac{2}{3}$) or 1;16,40 (= 1 $\frac{5}{18}$ or 1.27778 decimal). The length (*šiddu*) is said to be 1, the *šiliptu* 1,20 (its known coefficient) and their sum 2,20. So, if the 1,20 is taken (with Goetze, see above) as 80, the *šiddu* must be taken as 60, i.e. 1,00; (sexagesimal). This leads to a quadratic equation, either (a) or (b) below. From the solution given on the tablet we know³⁶ that the product 26,40 × 1,16,40 must be 34,04;26,40 and this determines the place values of these numbers used in the equations below.

$$26;40 L^2 + 1,00; L + 1,20; L = 1,16;40 \quad (a)$$

$$26,40; L^2 + 1,00; L + 1,20; L = 1;16,40 \quad (b)$$

Equation (a) has the solution $L = \frac{1}{2}$ and equation (b) has $L = \frac{1}{120}$. (Of course, each quadratic equation has two solutions but negative solutions are discarded.) We thus have two possible solutions:

TABLE 2
Values of areas and lengths determined by equations (a) and (b)

Item	eq. (a) with $L = \frac{1}{2}$		eq. (b) with $L = \frac{1}{120}$		Goetze's
	term in eq.	value	term in eq.	value	value
Area	26;40 L^2	= 6;40	26,40; L^2	= 0;06,40	26,40;
<i>šiliptu</i>	1,20; L	= 40;	1,20; L	= 0;40	1,20;
<i>šiddu</i>	1,00; L	= 30;	1,00; L	= 0;30	
<i>tallu</i>					48;
<i>pirku</i>					33;20

edition was included in his *Textes mathématiques babyloniens* (1938), 74–6) the parallel sides are called *pūtu elitum* and *pūtu šaplītum*, “upper and lower front”, the oblique sides *šiddu elātum* and *šiddu šaplātum*.

³⁶ In order to make the root $\sqrt{1,21,40; + 34,04;26,40}$ give the desired result 1,23;20 as given by Bruins; then $x = -1,10; + 1,23;20 = 13;20$ as required in Bruins’ restoration.

But, as shown above, Goetze's figure requires the area to be 26,40; not 26;40 [as in (a)]. Moreover, since the *apsamikku* described by equation (a) has an area of $6\frac{2}{3}$ and one side has a length of 30, its other side must be very short; it would become improbably long and narrow, like a rod or a pipe. It is only in equation (b) that the proportions of the figure as defined by Goetze are approximately preserved and the figure has a credible shape. The sum of the three terms as stated in the problem has thus to be understood as 1;16,40. The problem on the reverse of the tablet demands the same solution.

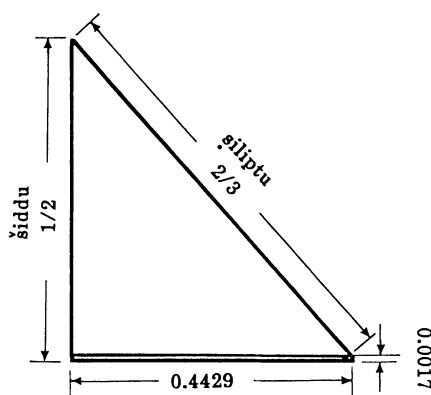


Fig. 4.

The trapezium that corresponds to equation (b) is shown in Fig. 4. The *tallu* and the very short parallel side have been calculated so that the area is correctly given and Pythagoras's theorem satisfied, ensuring that the *šiddu* and the *tallu* form a right-angle triangle. This figure incorporates the area and the two sides given in the problem, while at the same time it resembles the trapezium of Goetze with its extremely skinny rectangle attached to the short side of a right-angle triangle. We see this as further support for a harp-like *apsamikku*.³⁷ We do not at present see any way of reconciling this result with the line of commentary quoted above, p. 39, as it stands, but the discrepancy does not affect the main issue.³⁸

Minor points

One small problem remains: the connection of the *sammû* instrument with the “hand”. Immediately after the *sammû* (with Sumerian *ár.ri*, not *zà.mí*) in the vocabulary Diri III 52 (passage cited in *MSL* VI, 119) there follows *giš.šu.gál*, lit. “having a hand”, with Akkadian equivalent *me-in-di-ú*. In Hh VIIB, 88, the entry takes the form *giš.šu.[gál].zà.mí* = *ma-an-du-ú*, possibly “harp having a hand” or

³⁷ It must be mentioned that no coefficient for the *šiddu* of the *apsamikku* is given in the list and in Goetze's figure (Fig. 2 b here) the long side, which should be the *šiddu*, is not 60 but 1,05;20 (= $65\frac{1}{3}$ decimal); there is no other dimension which could be considered to be the *šiddu*. Does this indicate a flaw in the argument or only that the proportions of the figure could vary slightly?

³⁸ A possible explanation would be that the original text had only *ap-ta* (or better *ap-tu*) in the sense “(window) frame” posited by Goetze (see above), and the preceding U (“hole”) and the equation *ha-si-si* were added by a scribe who misunderstood the meaning. Hunger's reading *aš-šu-u* would be unparalleled and is unlikely to be correct.

“part of the harp having a hand”. This could perhaps be understood as an allusion to the type of horizontal harp having a model hand at the top of the pole, shown on several monuments³⁹ (Plate XIIa).

In an esoteric text in which parts of a god’s body are compared to various objects and substances, his hand is said to be a *sammû*-instrument, presumably indicating similarity of shape.⁴⁰ Whether this suggests a harp or a lyre is difficult to say. A lyre could be compared to a hand held upright with fingers spread like the strings; but a harp is not unlike a hand held slightly differently (Fig. 5). This comparison is therefore indecisive as to the nature of the instrument.

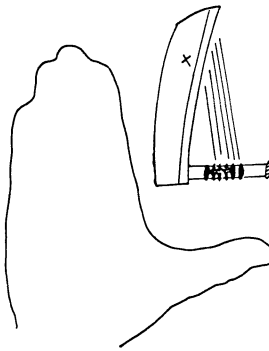


Fig. 5.

It should be noted that skin was used in the construction of the *z à . m í* (*Reallexikon* VI, 572, paragraph 2). We know that harps used leather/skin for acoustically important purposes (see the discussion of extant Egyptian harps above, p. 37) whereas lyres used wood. There is no skin on any extant Egyptian lyres; the lyres of Ur do not seem to have had it; nor is there skin on pictorial representations of lyres from this date.

The evidence of the number of strings

The *apsamikku* problem texts and the “lists of key numbers” (see above) go back to the Old Babylonian period, and the latter contain a passage naming the intervals between pairs of strings on a musical instrument. These intervals appear again in *Nabnitu* XXXII, which probably dates back to the Kassite period, and here the nine strings of the instrument are also named in their proper order. A tuning text of the Old Babylonian period has the same nomenclature and states that the instrument in question is the *sammû*.⁴¹ It is clear, therefore, that from the Old Babylonian period the *sammû*-instrument had nine strings.

There are no harps or lyres actually recovered from second and first millennium contexts. On the other hand, there are many depictions of instruments from this and

³⁹ For example, Rimmer, op. cit. pl. IX.

⁴⁰ *KAR* 307 obv. 3, cited in the *CAD* s.v. *sammû* 119b and now translated by A. Livingstone, op. cit., 94, “his hand is a harp”. The dictionary also cites a similar passage from an omen text: “If he has *sammû*-shaped hands.”

⁴¹ For a compendious account of these texts see A. Kilmer “The discovery of an ancient Mesopotamian theory of music”, *Proceedings of the American Philosophical Society* 115 (1971), 131–49.

earlier times but the pictorial style is often crude, due in part to the small size of the monuments. A comparison of the extant instruments (Table 3) at the time of Ur I and their representations (Table 4), throws light on the question of accuracy of string depictions.

TABLE 3
Extant instruments from Ur

<i>Name</i>	<i>No. of strings</i>	<i>Museum No.*</i>	<i>Publication</i>
"Gold lyre"	7, 8, 15**	IM 8694	Rashid, p. 30
"Silver lyre"	11	BM 121199	Rashid, p. 34
"Plaster lyre"	10 or 11	IM 8695	Rashid, p. 38
"Boat-shaped" lyre	11	UM 30-12-253	Rashid, p. 36
"Queen's harp" (arched)	13***	BM 121198	Rashid, p. 42
Harp, PG 1130	15		Woolley, UE II, 167

* BM = British Museum, London; IM = Iraq Museum, Baghdad, UM = University Museum, Philadelphia.

** Strings were not recovered, but markings on the body suggest one of these numbers.

*** It was formerly considered to have 12 strings (see Barnett, *Iraq* 31 [1969], 100) but an additional string peg was found during a recent restoration.

Representations show considerably fewer strings—with two exceptions: the "Peace Standard" from Ur (BM 121201) which has a lyre with eleven strings, and a stela dating from about 2100 B.C. (Louvre, AO 52, Rashid, p. 66). But both representations are also unusual in being fairly large and made from relatively hard materials: the lyre on the "standard" is incised on shell and the stele is a 1.25 m high limestone relief. The most common representations are reliefs on small terra-cotta plaques or seal cylinders where the strings are about five or so. Below are the monuments dated within 200 years of the first dynasty at Ur (taken from Rashid's collection, pp. 50–65).

TABLE 4
Representations of lyres and harps in Mesopotamia (2650–2170 B.C.)

<i>Type</i>	<i>Medium</i>	<i>Date (B.C.)</i>	<i>No. of strings</i>	<i>Museum No.</i>	<i>Rashid Abb. Nr.</i>
Lyres	Seal impressions	2650	4,4,4,4	VA 6408, 6598, 6667, 8629	19–26
Harp	Limestone reliefs	2600	5,5,5	IM 14661, A 18073, A 12417	32–35
Lyres	Cylinder seals	2450	5,5	IM 14597, UM 30-12-3	26, 24
Harp	Cylinder seal	2450	4	CBS 16728 (UM)	29
Harp	Seal impressions	2450	3,4	U 18408/896-7, 18413/916*	30–31
Lyre	Limestone relief	2550	8	IM 66157 (Rashid, p. 60)	36
Lyres	Seal impressions	2350–2170	5,7	IM 33287, AO 2371	41, 42

A = Oriental Institute Museum, Chicago; VA = Vorderasiatisches Museum, East Berlin. The examples in the table are all independent, i.e. only one impression is counted for each mould or seal; all harps are "boat-shaped".

* Field numbers, now in the University Museum. The number 33-35-252 given by Rashid for Abb. 31 is incorrect.

In Sumerian times, then, string counts on representations are usually too low. That was probably also the situation at the time of the Old Babylonian kingdom when relatively few strings (4–7) were still shown on representations of harps (vertical and horizontal angular types). An exception is a horizontal harp [Legrain: *Terra-cottas from Nippur* (1930), 19, Fig. 93] with a string count of 9. The arched harp on the Eshnunna plaque in the Louvre (AO 12454, Rashid, p. 89) has 6 strings but the fringe has 8. For the lyre we have a Larsa sherd showing 8 strings and an Işçali terracotta showing 12 strings (Collon, *RIA* VI, 579, k, 1). Thus the string count on contemporary monuments also provides some evidence in favour of the Old Babylonian *sammû* being a harp rather than a lyre.

TABLE 5
String instruments on Assyrian Palace reliefs

Date (B.C.)	No. of strings	British Museum No.
Horizontal harps:		
865–860	9 (6 harps)	124533, 124535, 124550
704–681	9	124948
704–681	8	124948
660–650	10	124802 (Elamite orchestra)
645–635	7	124886
Vertical harps:		
660–650	20–30 (7 harps)	124802 (Elamite orchestra)
645–635	17* (2 harps)	124920, 124922

* Result extrapolated from 14 visible strings.

In Assyrian times, however, the palace reliefs provide a much more reliable testimony of string counts since the general style of the carvings is finer with minute details shown in a consistent manner. The results are summarized in Table 5. This iconographic evidence shows that the Assyrian and perhaps also the Old Babylonian horizontal angular harp most often (7 out of 10) had 9 strings. The Assyrian vertical angular harp, on the other hand, had more. Seventh century Elamite rock sculptures at Kul-e Farah⁴² confirm the observation: a horizontal angular harp has 9 strings and a vertical one has 15. The string counts thus tend to corroborate the surmise that the term *sammû* may also have been used for the horizontal harp of Old Babylonian times.

In this situation, with the sound holes (*hasīs sammû*) well attested for the vertical harp but only suggested for the horizontal harp, with 9 strings attested for the horizontal harp but not for the vertical harp—which probably had more, as it did later—we feel that *zà.mí/sammû* probably was a general term for both types, vertical and horizontal. Specifically, “the 9-stringed *sammû*” would have been the latter.

⁴² Bo Lawergren and Eric de Waele, *Elamite musical instruments at Kul-e Farah*, (to be published).

APPENDIX

The coefficient of the *hasīs sammī*.

The area of the *hasīs sammī* is shown as a hatched field in Fig. 6. It is formed between tightly packed circles of radius R . Their centres are located at the corners of a square with sides $2R$. Since the circles constitute the sides of the *hasīs sammī*, the

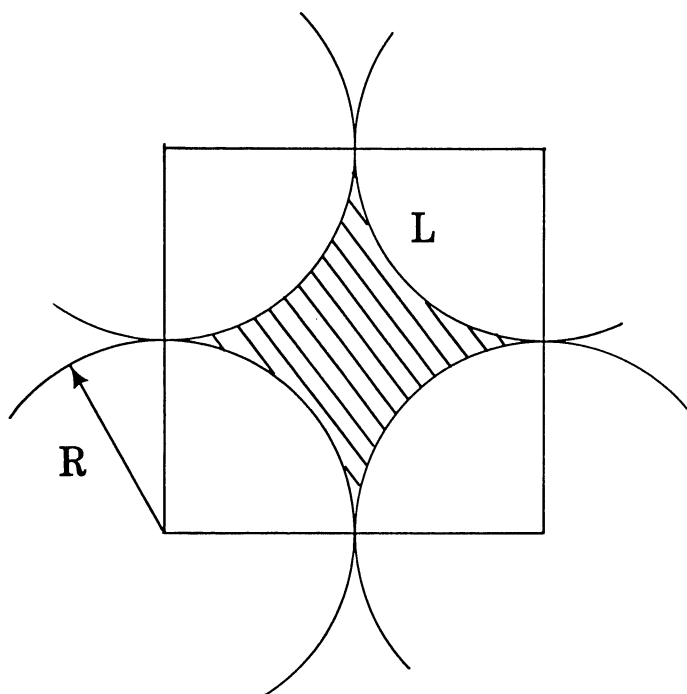


Fig. 6.

length (L) of one of its sides is a quarter of a full circumference, $L = \pi R/2$ or $R = 2L/\pi$. The area (A) is obtained by subtracting the area of one full circle from the area of the square:

$$A = (2R)^2 - \pi R^2 = R^2 (4 - \pi)$$

Substituting $R = 2L/\pi$ we have

$$A = L^2 (16/\pi^2 - 4/\pi)$$

Here the expression in the bracket is, by definition, the coefficient C . As was usually done, the value of π was taken as 3 (see our discussion above of the coefficient for the circle). In that case the coefficient becomes

$$C = 16/9 - 4/3 = 4/9$$

The last fraction equals 0;26.40 (in sexagesimal notation) which is the value for the coefficient given on the tablets.

PLATE X



a.



b.

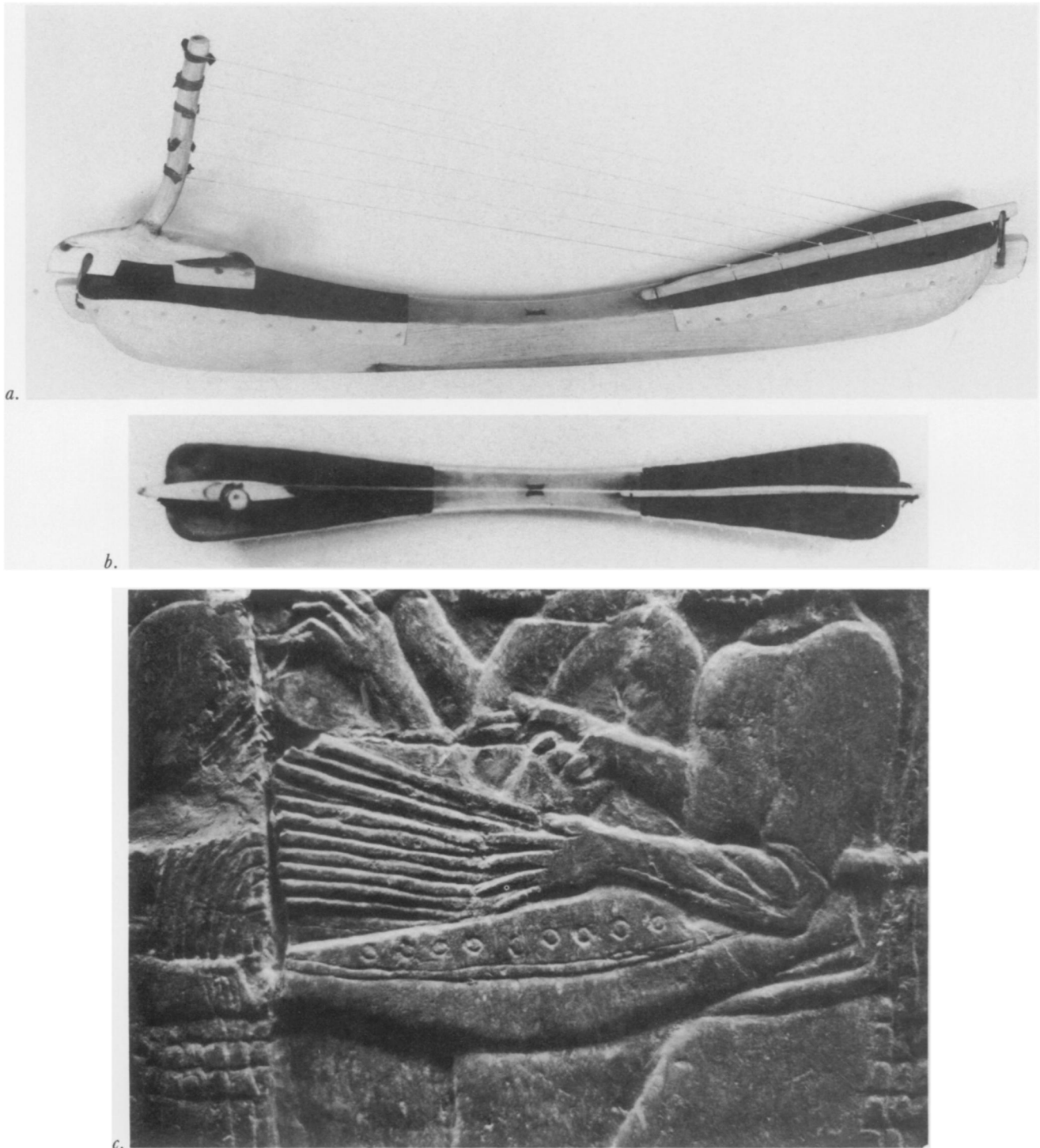


c.

a. The upper part of the body of the vertical angular harp showing a pair of "concave rectangles"; from Assurbanipal's north palace at Nineveh (British Museum 124922).

b. A vertical harp in the Elamite orchestra. The upper part of the body shows a pair of "concave rectangles"; from Assurbanipal's south-west palace at Nineveh (British Museum 124802).

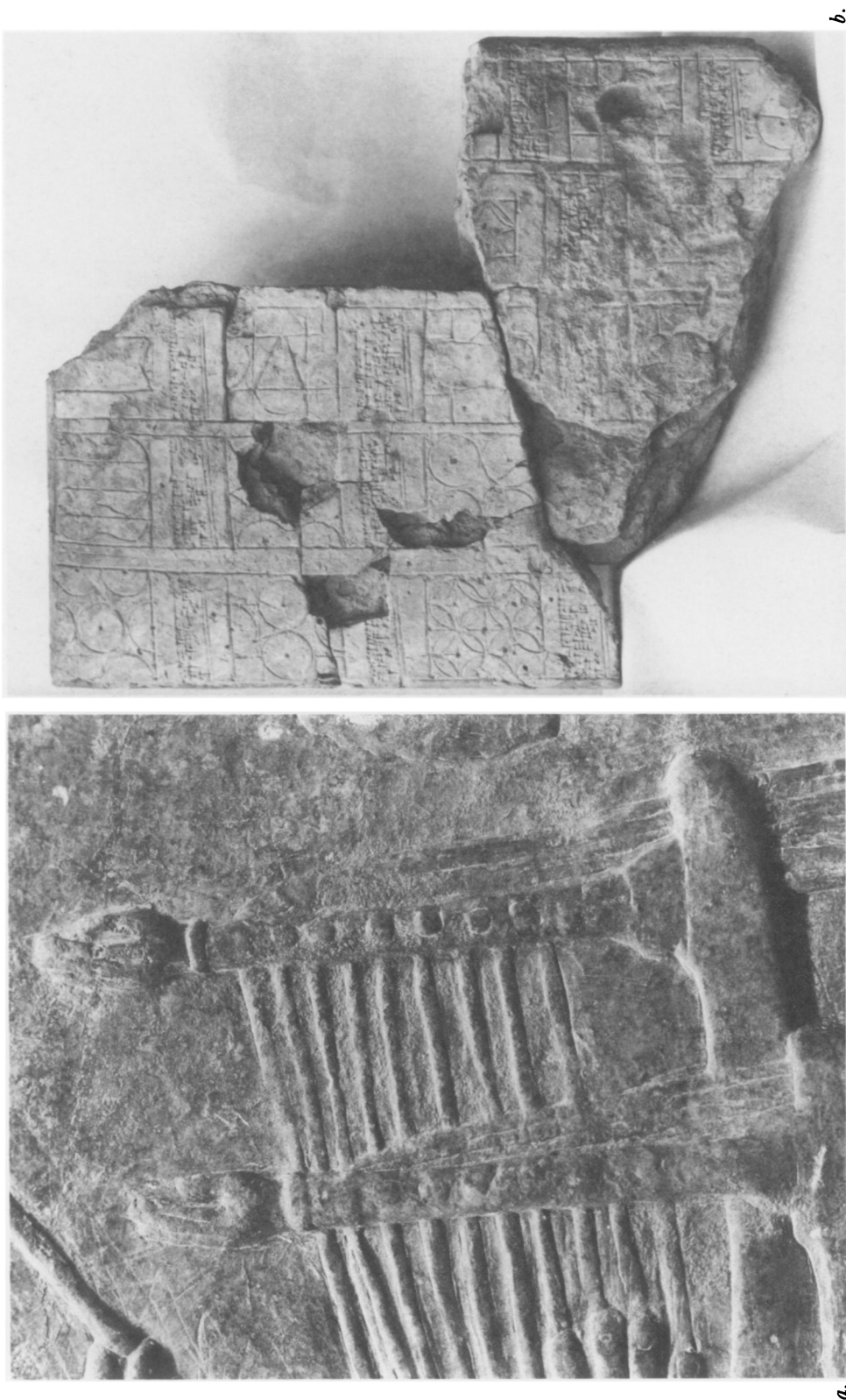
c. The vertical harp at Assurbanipal's garden party; from the north palace at Nineveh (British Museum 124922).



a-b. Reconstruction of the horizontal harp from Pazyryk in the Altai region of southern Siberia; *a*, side view and *b*, a vertical view which shows the sound hole in the shape of a “concave rectangle”.

c. A horizontal angular harp in the Elamite orchestra; from Assurbanipal’s south-west palace at Nineveh (BM 124802).

PLATE XII



a. The vertical sticks on two horizontal angular harps at the north-west palace at Nimrud of Assurnasirpal II (BM 124533).

b. Tablet with geometrical problems; from British Museum (BM 15285).